Pediatric Malnutrition: cased based approaches from Nutrition and Gastroenterology

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Disclosure

Liliane Diab M.D.
Jason Soden M.D.

No relevant financial disclosures to report.

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Diagnosis and Assessment of Severity

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1. Discuss the standardized criteria for diagnosing pediatric malnutrition
2. Differentiate between malnutrition and appropriate or expected growth
3. Review the different types of growth charts

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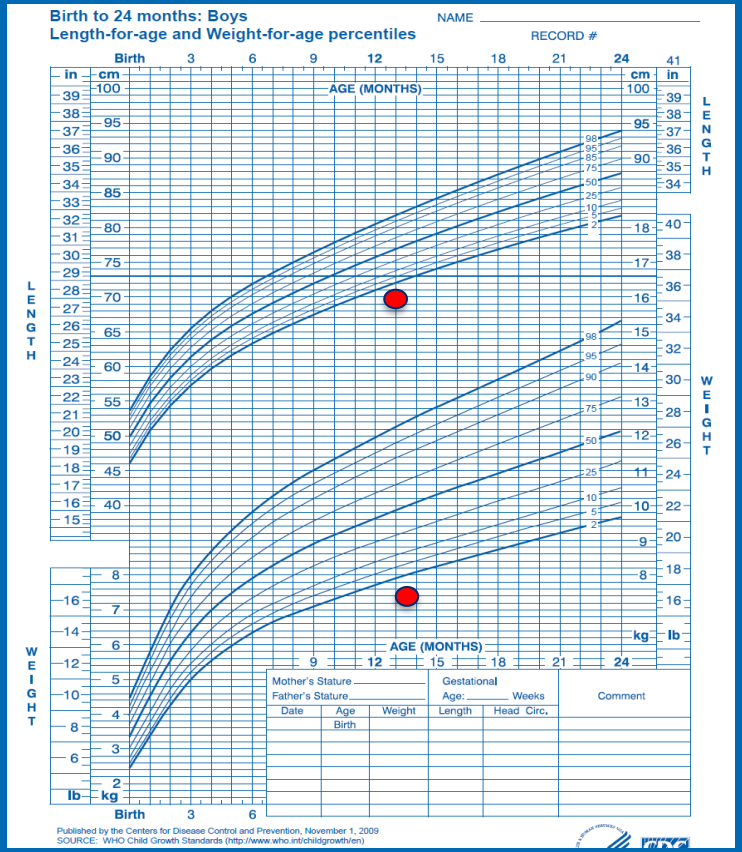
Defintions

Underweight

- > 2 SD below median (50th percentile)
- < 2nd %ile for age
- Underweight ≠ Wasting

Stunting

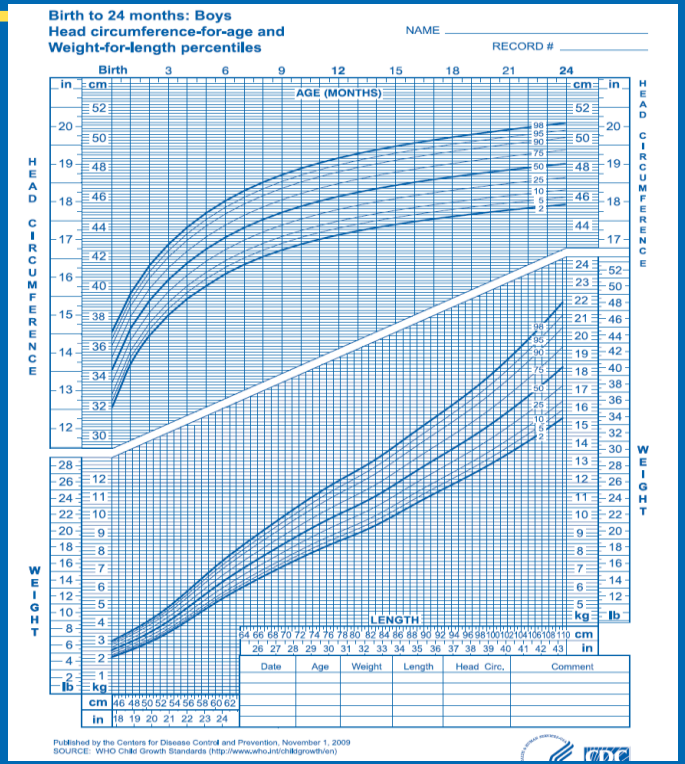
- **Length z score** ≤ -2
- Severe : Length z score ≤ -3



Centers for Disease Control, 2009

See References slide for additional information.

Wasting= Protein Energy Malnutrition (PEM)



- ↓ weight relative to the length (under 2)
- ↓ weight relative to the height (BMI chart for >2)
- "Ideal Body Weight"(50th % W/L or ht)

90-110 % Normal

80-89% Mild

70-79% Moderate

Less than 70% severe

Center for Disease Control, 2009

See References slide for additional information.

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Normal Weight Gain

0-3 months 25-30 g per day (closer to 20-30 g/d after the 1st month of life)

3-6 months 15-20 g per day

6-9 months 10-15 g per day

9-12 months 10 g per day

After 12 months 6 g per day

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See References slide for additional information.

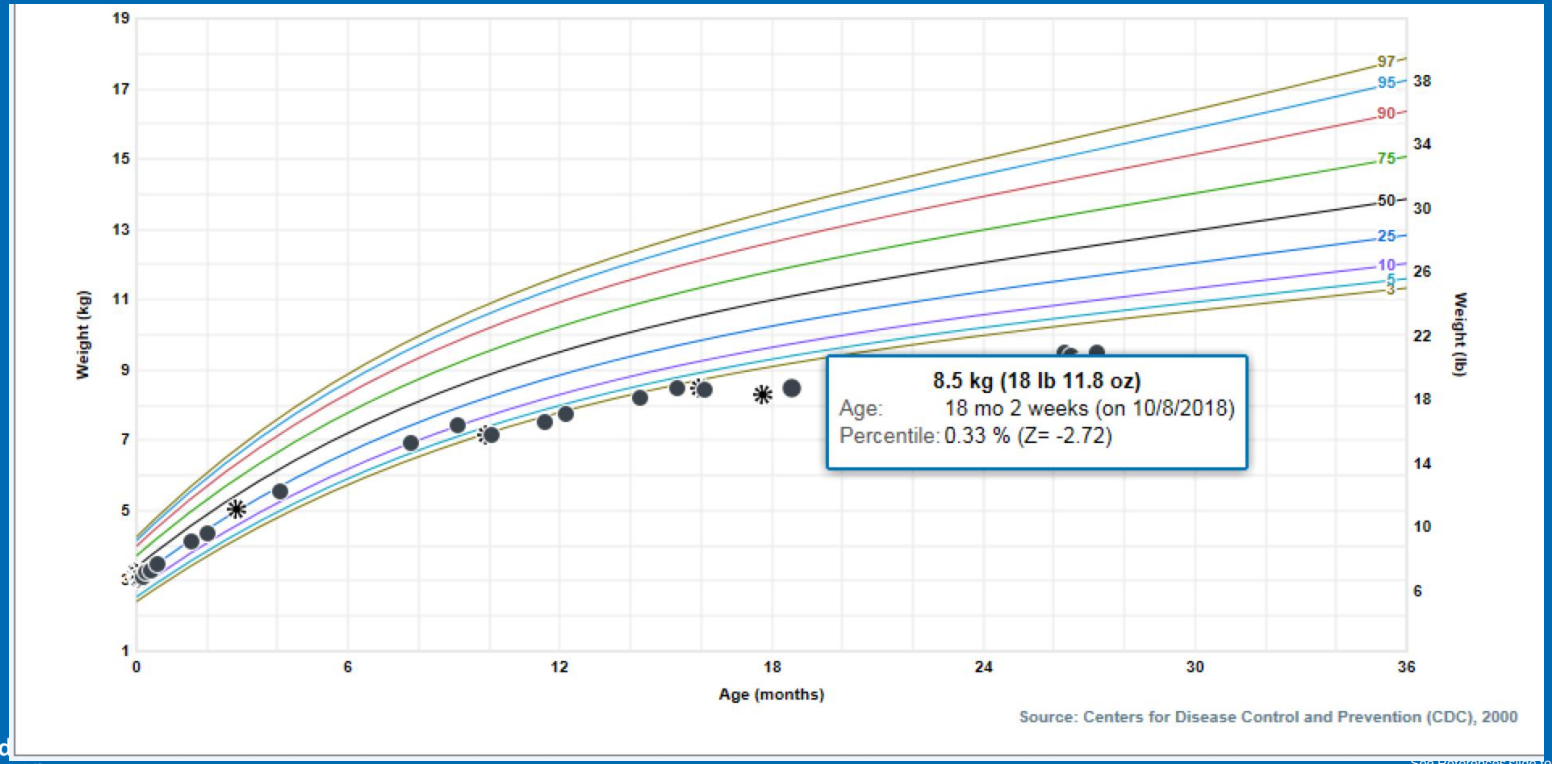
Diagnosing Malnutrition

Method	No malnutrition	Mild malnutrition	Moderate malnutrition	Severe malnutrition
Weight for height percent of median	>90%	80-89%	70-79%	<70%
Weight for height z score	> -1	-1 to -1.9	-2 to -2.9	< -3
BMI z score	> -1	-1 to -1.9	-2 to -2.9	<-3
Length/height z score	Not Applicable	No data but z score less than -2 suggest stunting	No data but z score less than -2 suggest stunting	<-3

See References slide for additional information.

Case Study 1

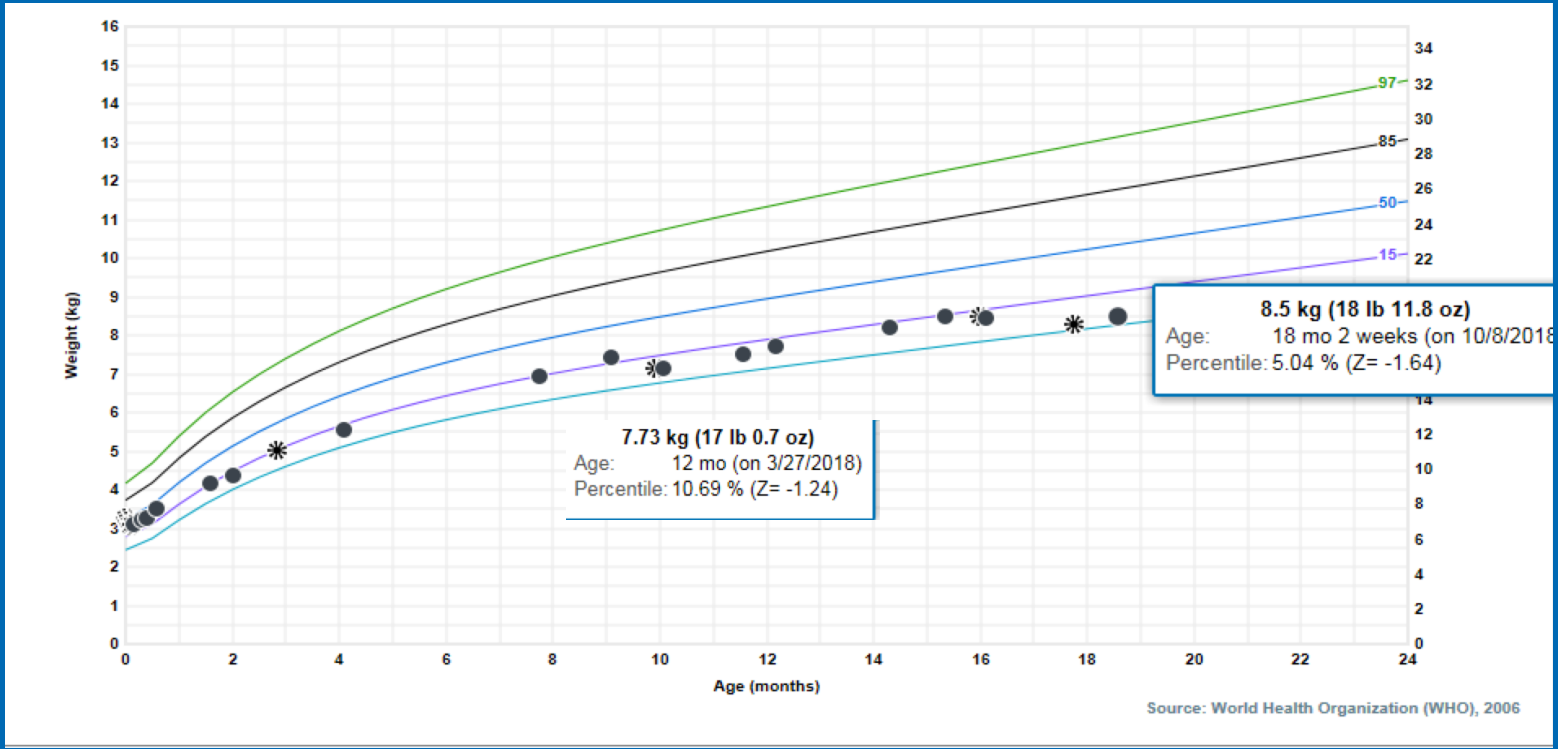
18 ½ months old former term infant AGA referred to CHCO for growth faltering



(CDC, 2000)

See References slide for additional information.

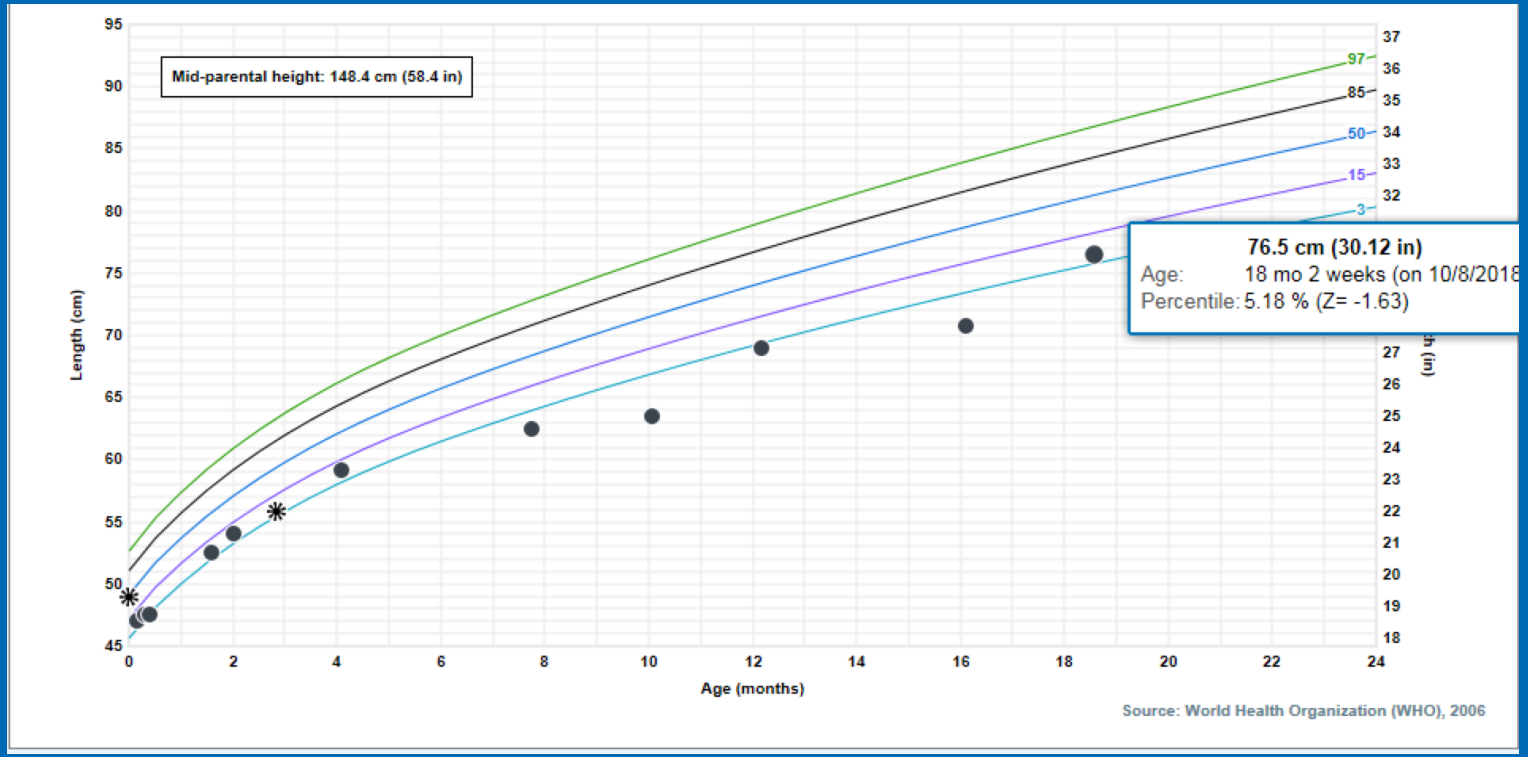
Case Study 1: Weight (WHO Chart for 0-24 months)



(WHO, 2006)

See References slide for additional information.

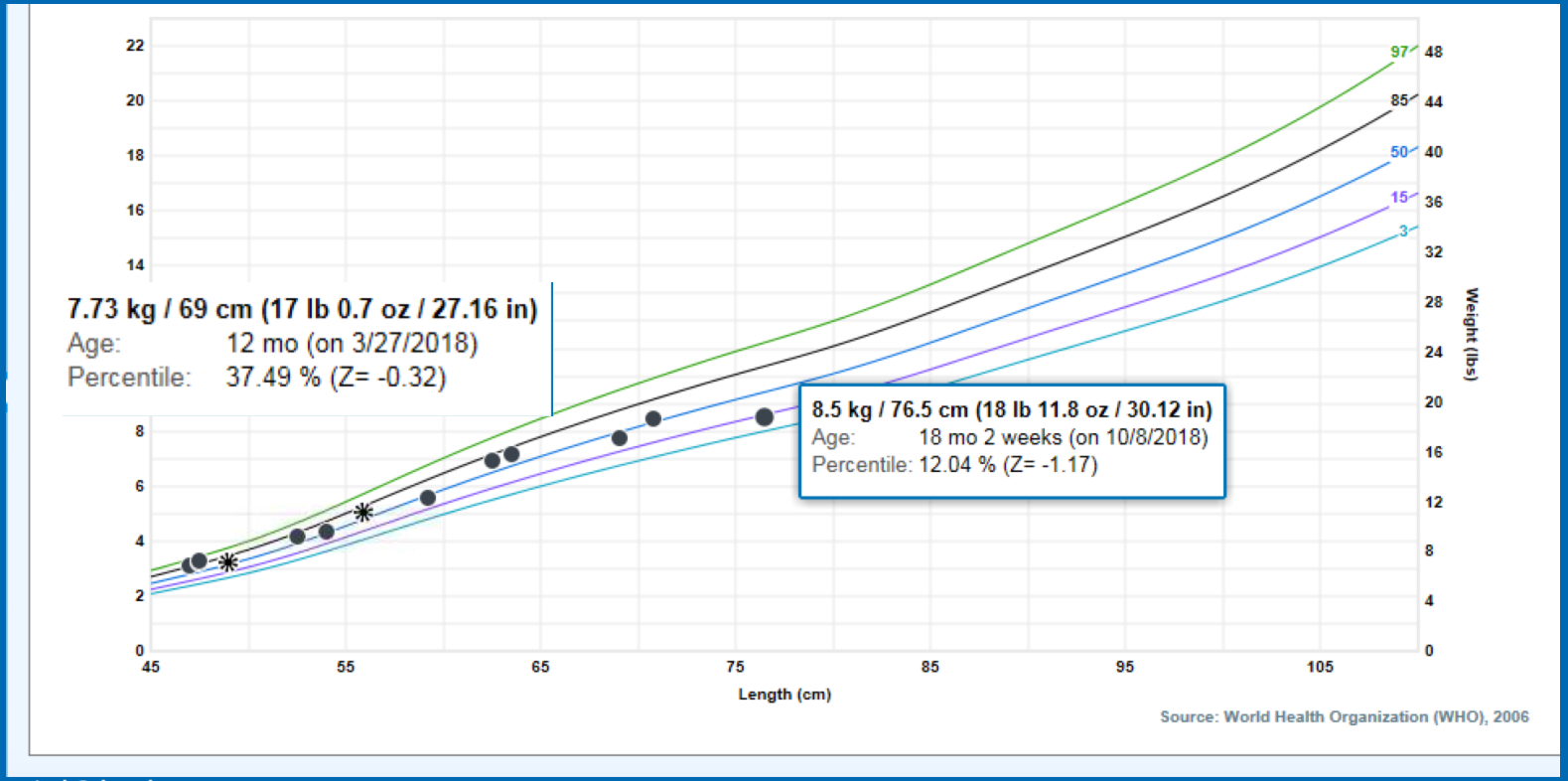
Case Study 1: Length



(WHO, 2006)

See References slide for additional information.

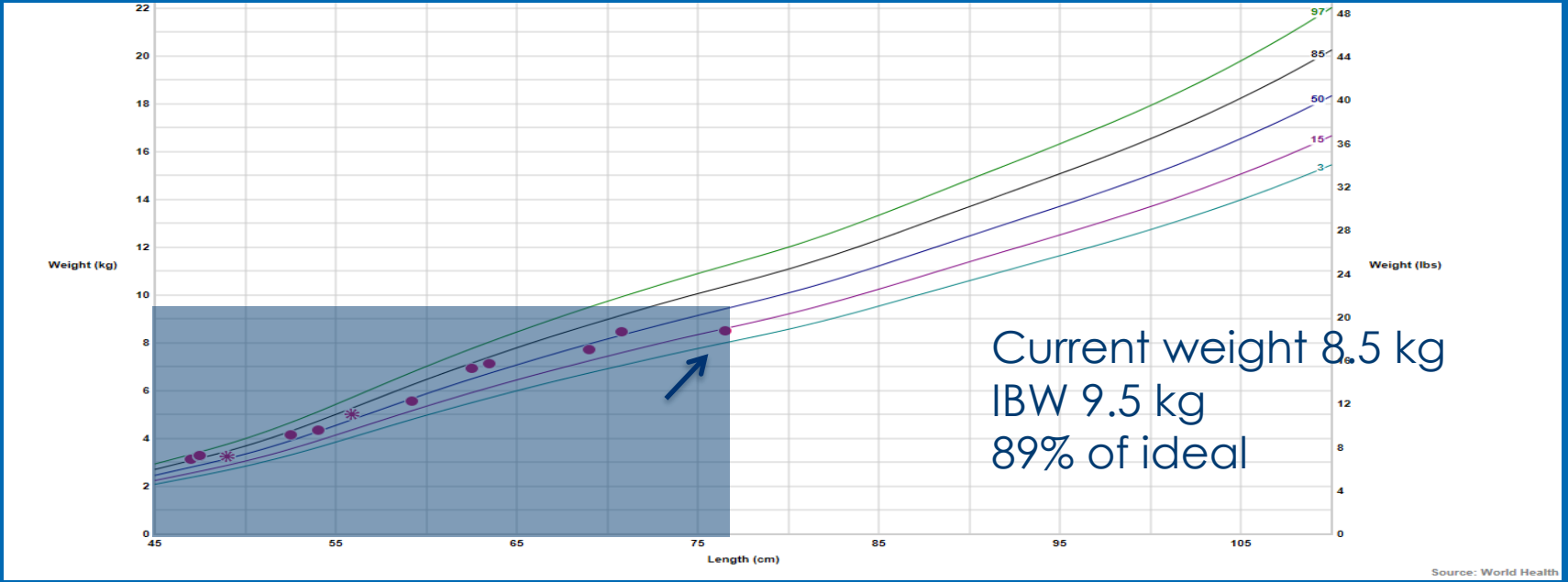
Case Study 1: Weight for Length



(WHO, 2006)

See References slide for additional information.

Ideal Body Weight for under 2 use weight for length chart.



(WHO, 2006)

See References slide for additional information.

Case Study 1: Nutrition Status Assessment

✓Weight for length z score -1.19
✓89% of ideal body weight

Final Assessment:
Mild Malnutrition

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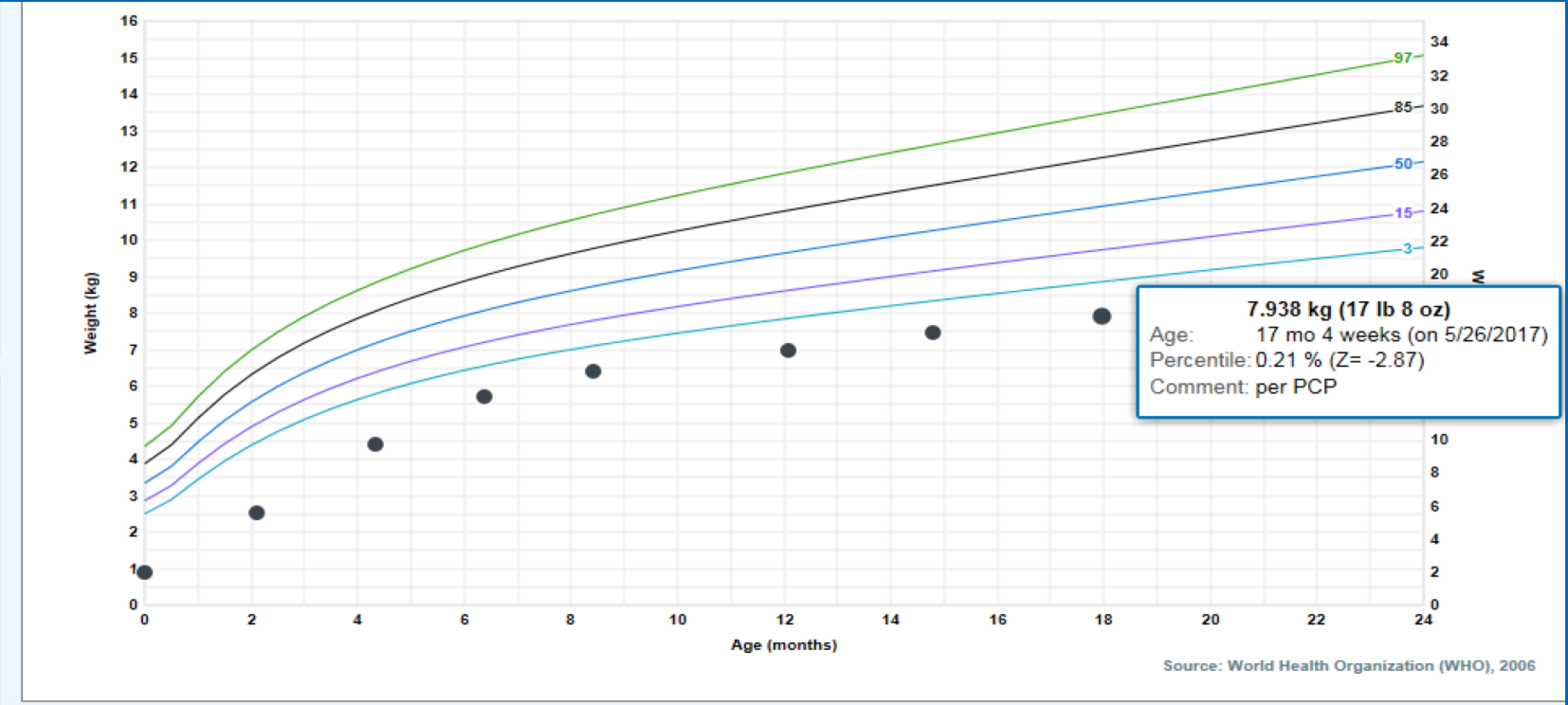
See References slide for additional information.

Case Study 2 18 months old former 32 weeker



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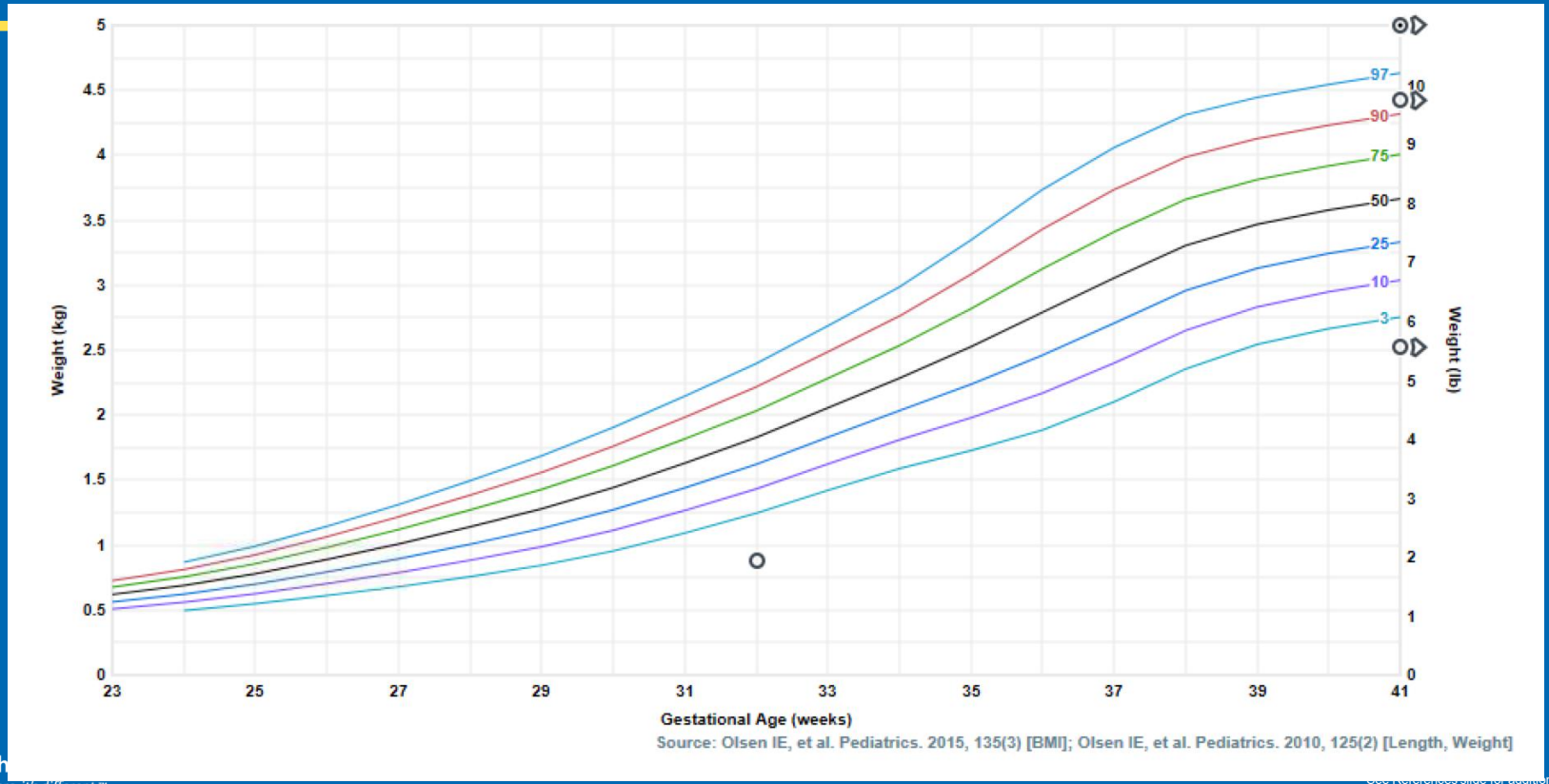
(WHO, 2006)

See References slide for additional information.

Fenton or Olsen Chart



(Olsen, 2015)

Which Growth Chart to use for a premature infant?

- Up to 36 weeks gestation : Olsen (not suited for monitoring)
- 36-50 weeks corrected GA : Fenton
- 4-8 weeks post term use WHO charts (correct for prematurity until age 3)

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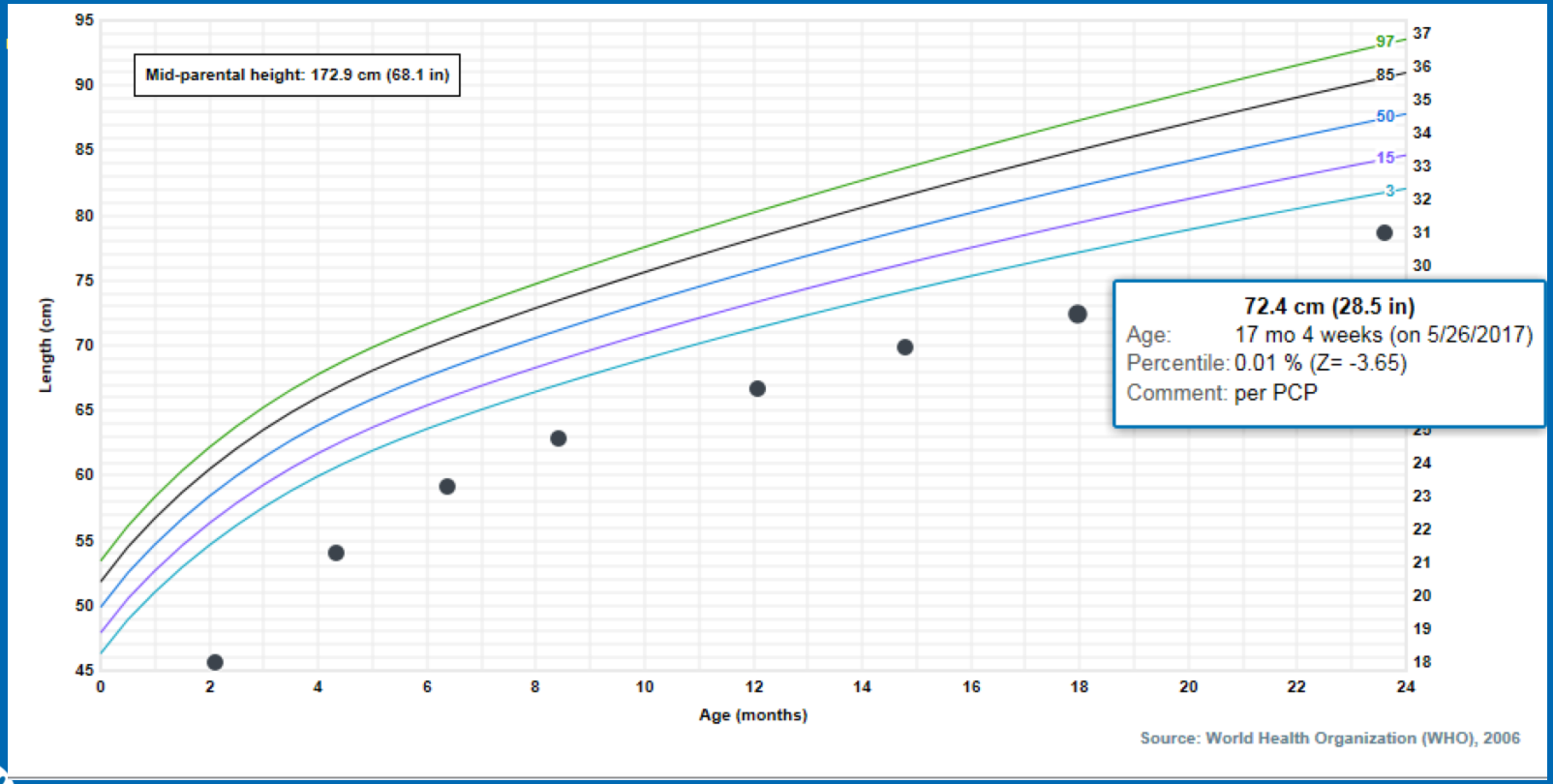
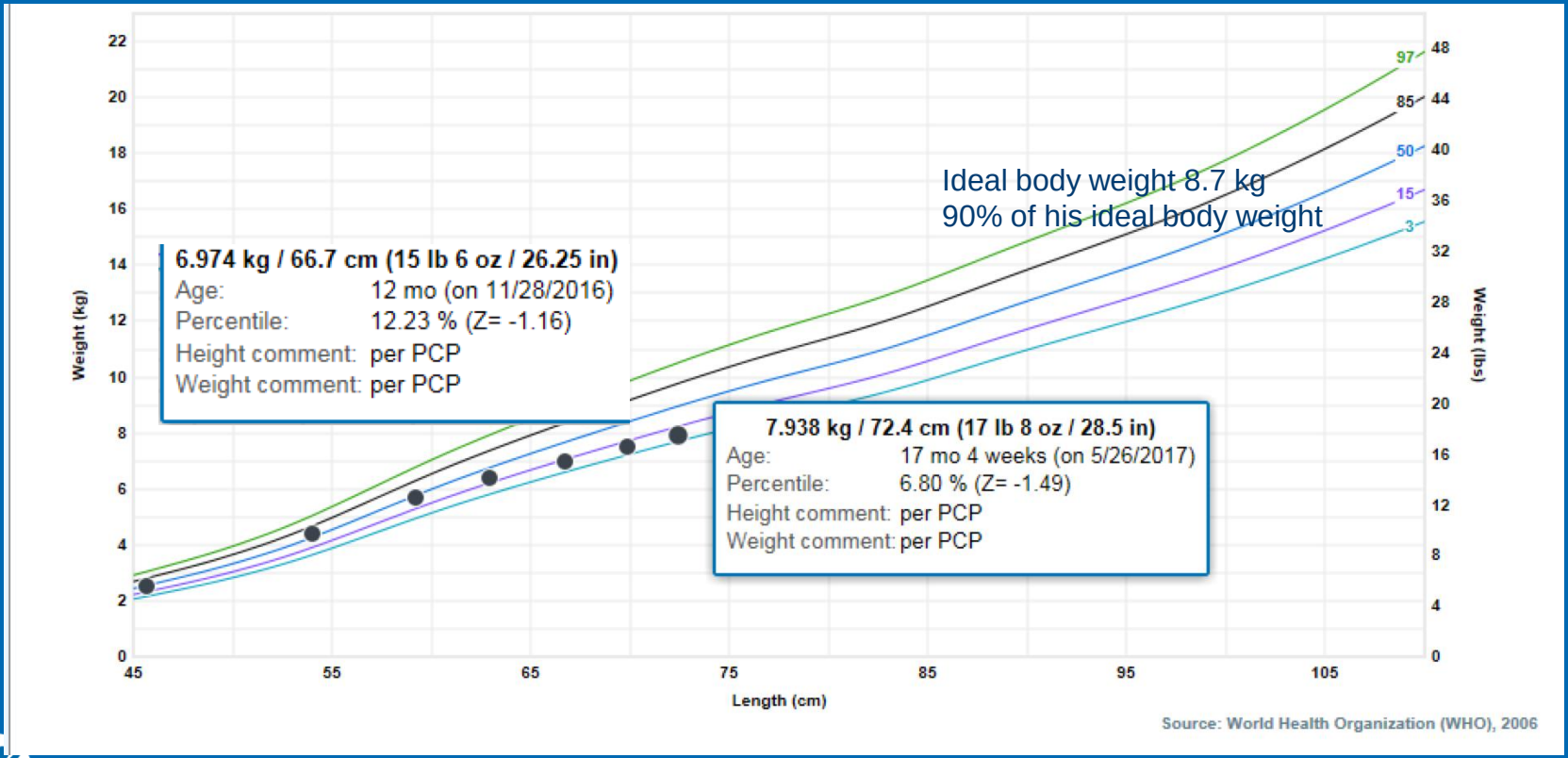
Case Study 2: Length



(WHO, 2006)

See References slide for additional information.

Case Study 2: Weight for Length



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(WHO, 2006) See References slide for additional information.

Case Study 2: Nutrition Status Assessment

✓Weight for length z score -1.49
✓90% of ideal body weight
✓Length z score less than-3 (even when corrected for gestational age)
✓Weight gain velocity is normal

Final Assessment: normal nutrition status with short stature for age (it may take until 3 years old to achieve a catch-up linear growth)

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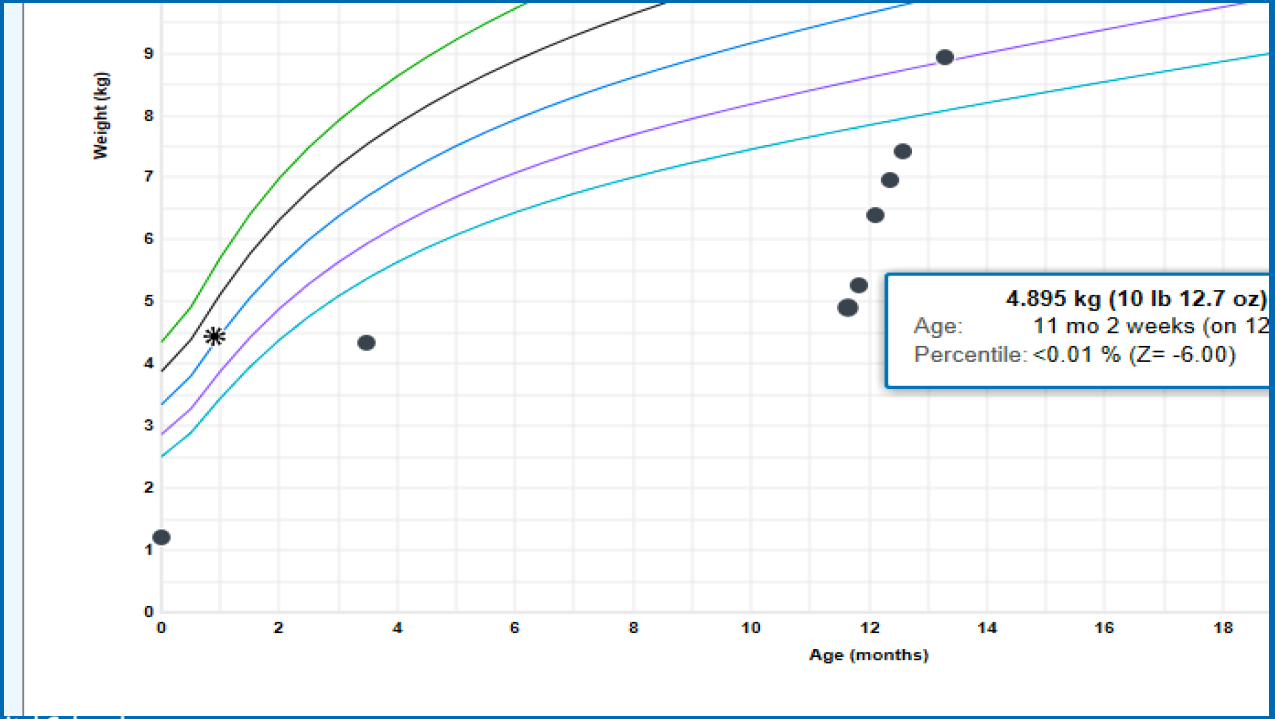
See References slide for additional information.

Case Study 3

11 months old former 27 weeker

BWT : 2lb 11 oz, (AGA? SGA? OR LGA?)



(WHO, 2006)

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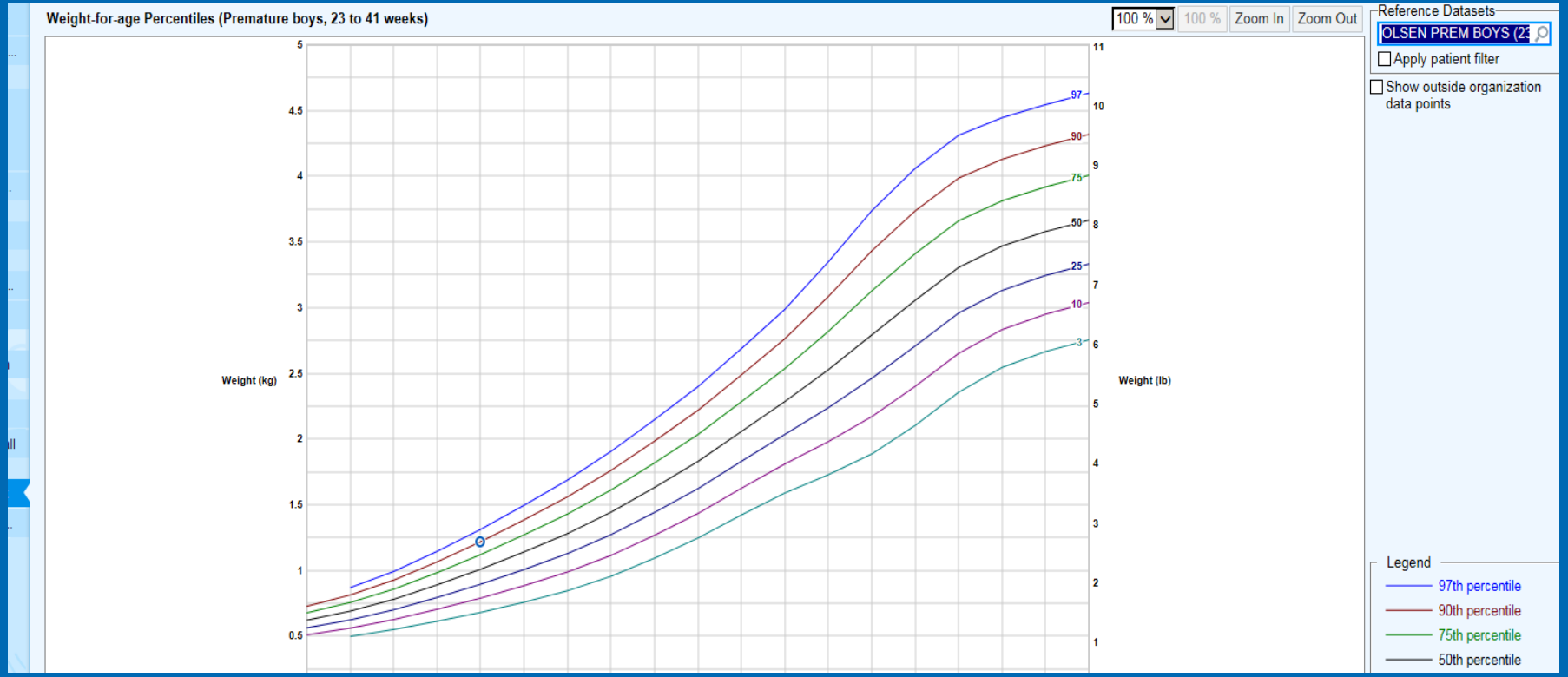
Olsen Chart



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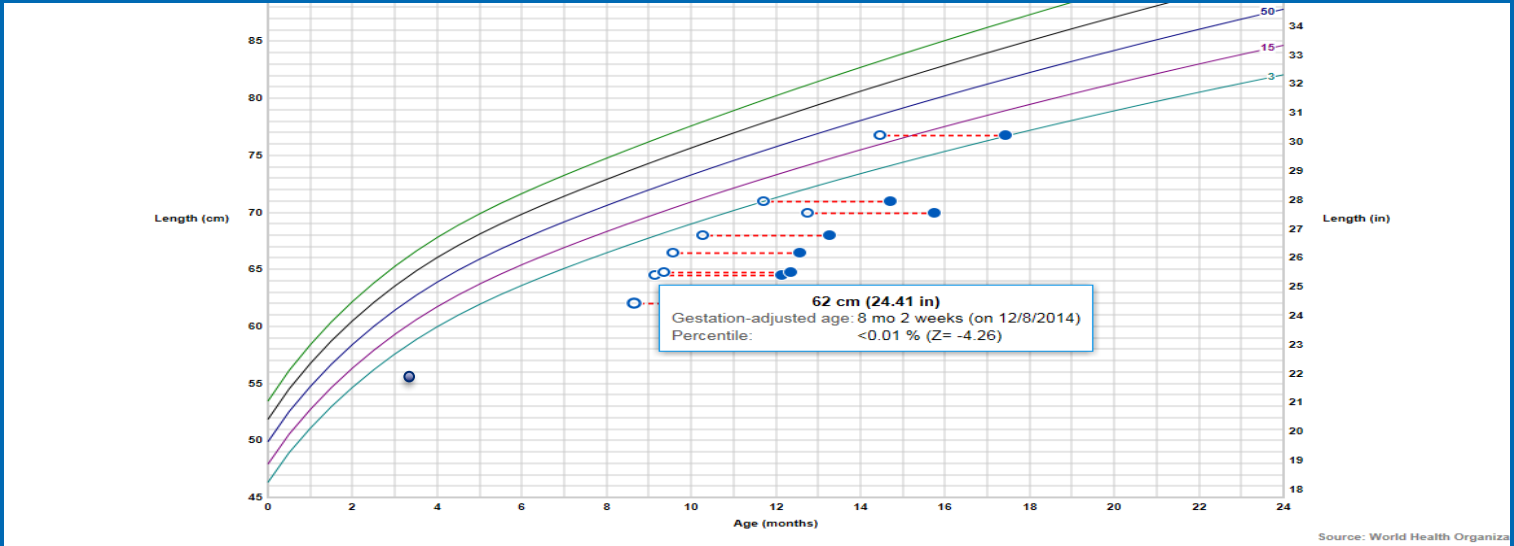
(Olsen, 2015)

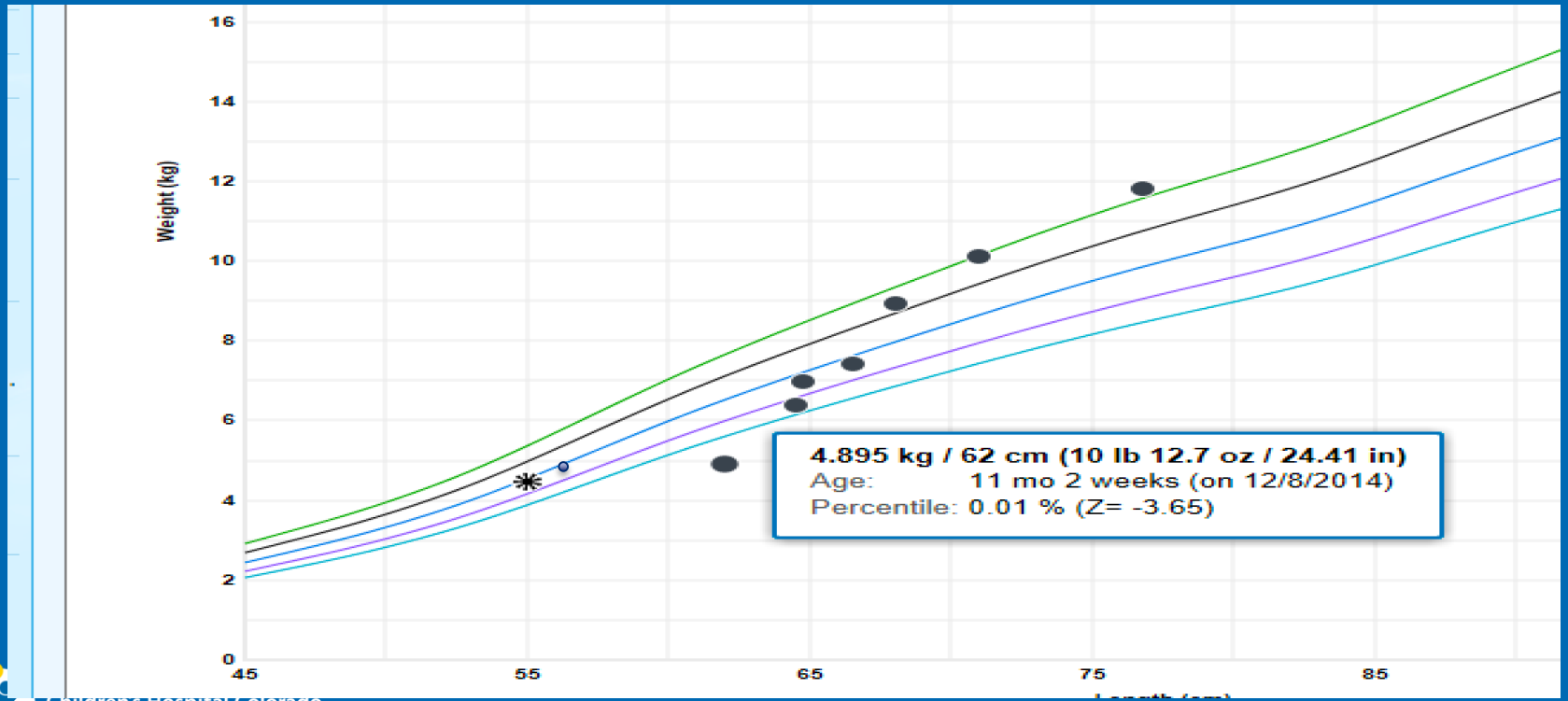
Length



(Olsen, 2015)

Weight for Length

Current weight 4.8 kg
IBW 6.8 Kg
72% of ideal with severe stunting



(Olsen, 2015)

See References slide for additional information.

Case Study 4 Nutrition Status Assessment

- ✓ 72% of ideal body weight
- ✓Weight for Length z score less than -3
- ✓Severe Stunting

Final Assessment :

Severe Malnutrition

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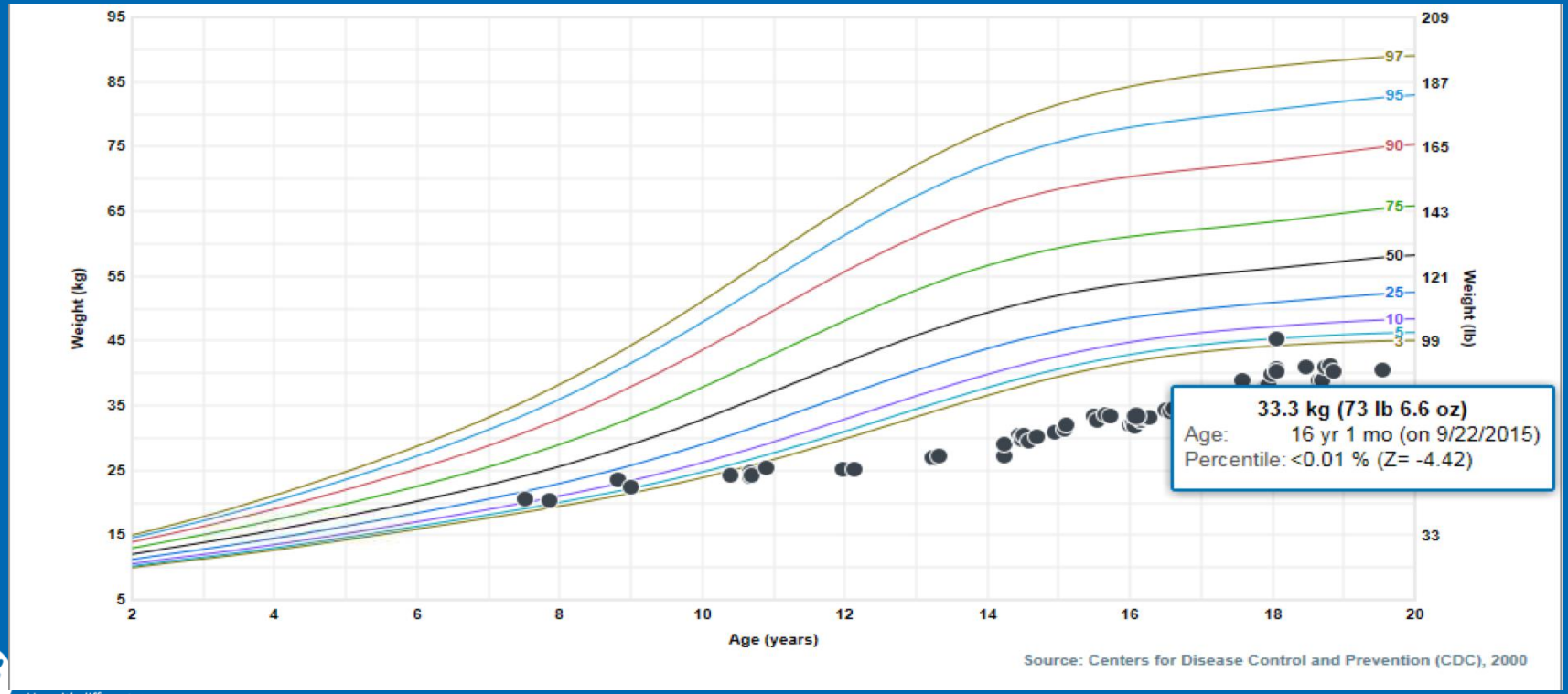
See References slide for additional information.

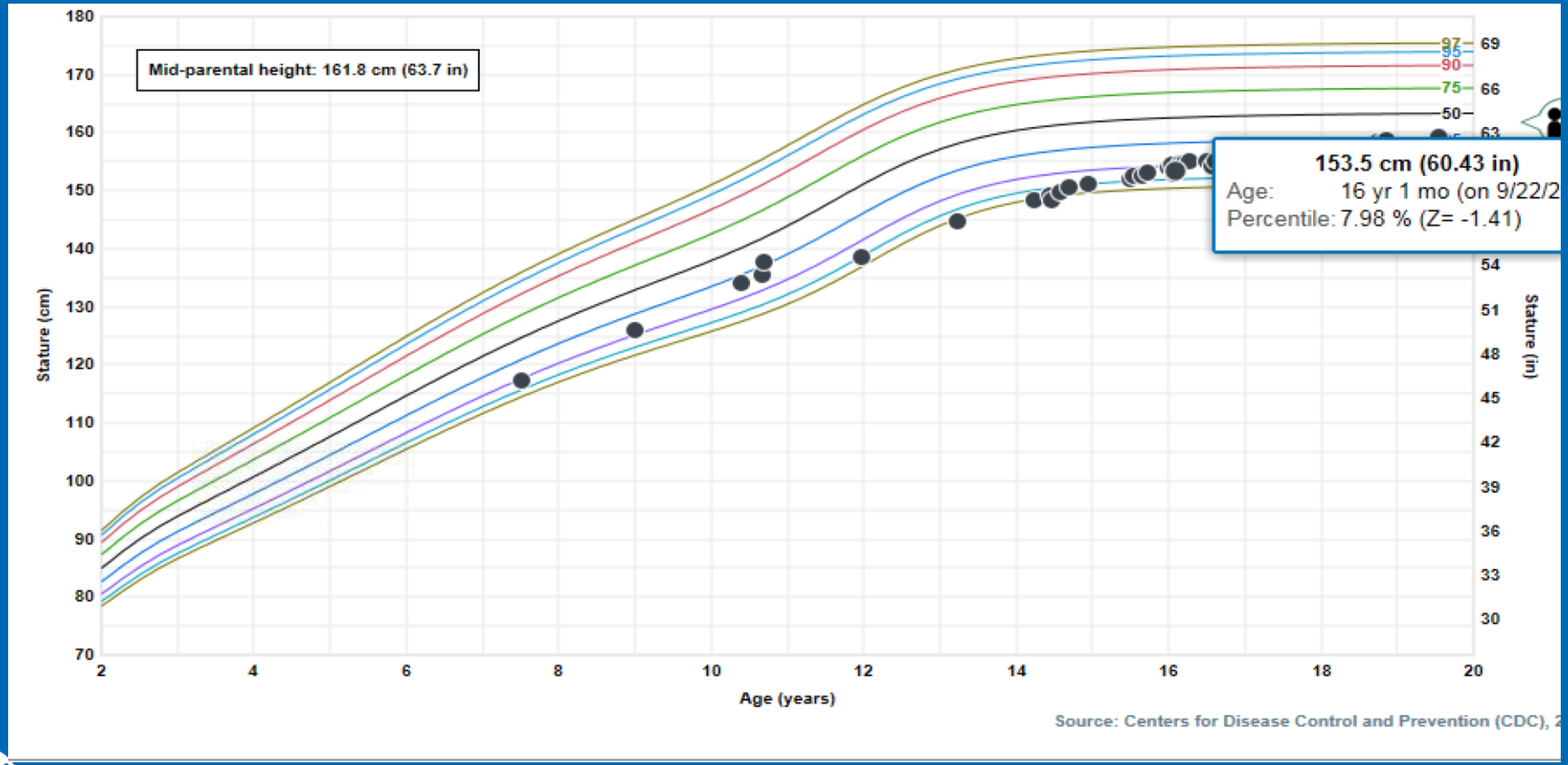
Case Study 4

16 years old with NF, referred for concerns about her weight gain



(CDC, 2000)

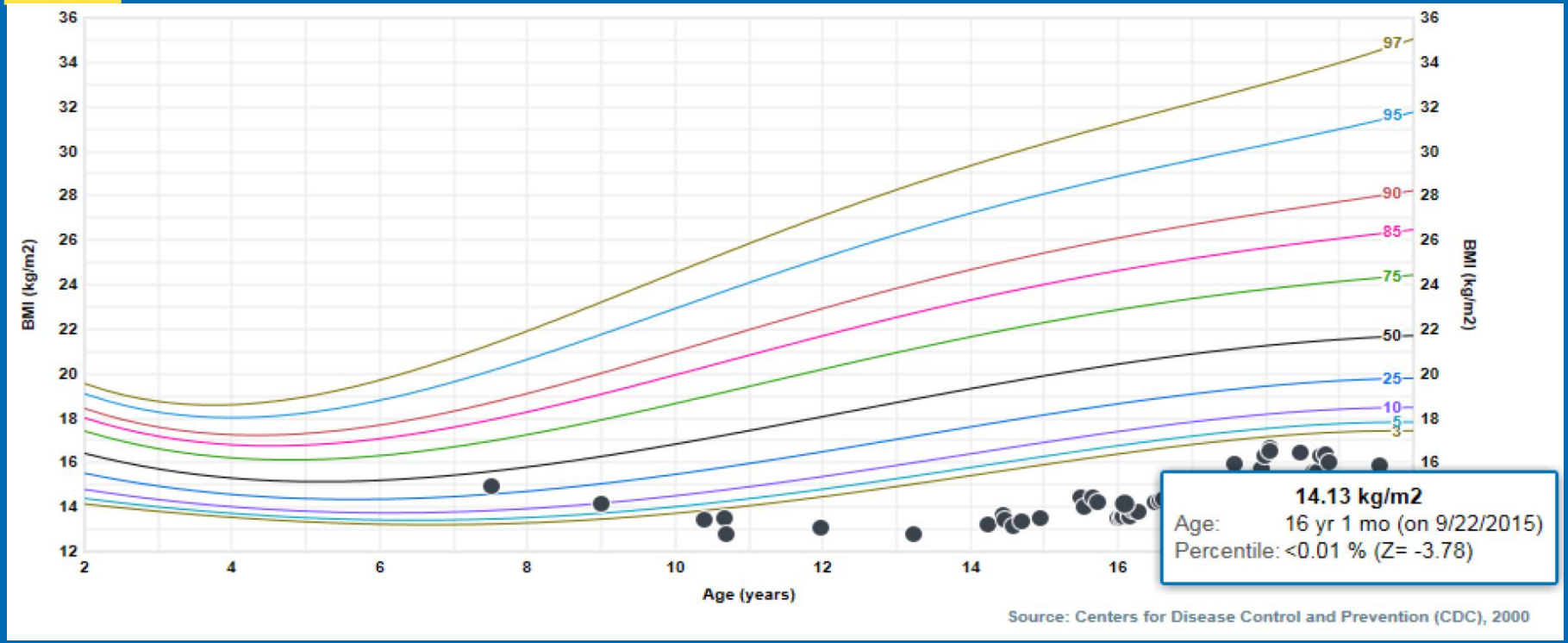
Case Study 4: Length



(CDC, 2000)

See References slide for additional information.

Case Study 4: BMI



(CDC, 2000)

See References slide for additional information.

Case Study 4: Nutrition Status Assessment

✓BMI z score less than -3

✓Percent of ideal body weight calculation based on BMI at 59th percentile was 67%

Final Assessment:
Severe Malnutrition

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See References slide for additional information.

Case Study 5

8 Years old referred for growth concerns

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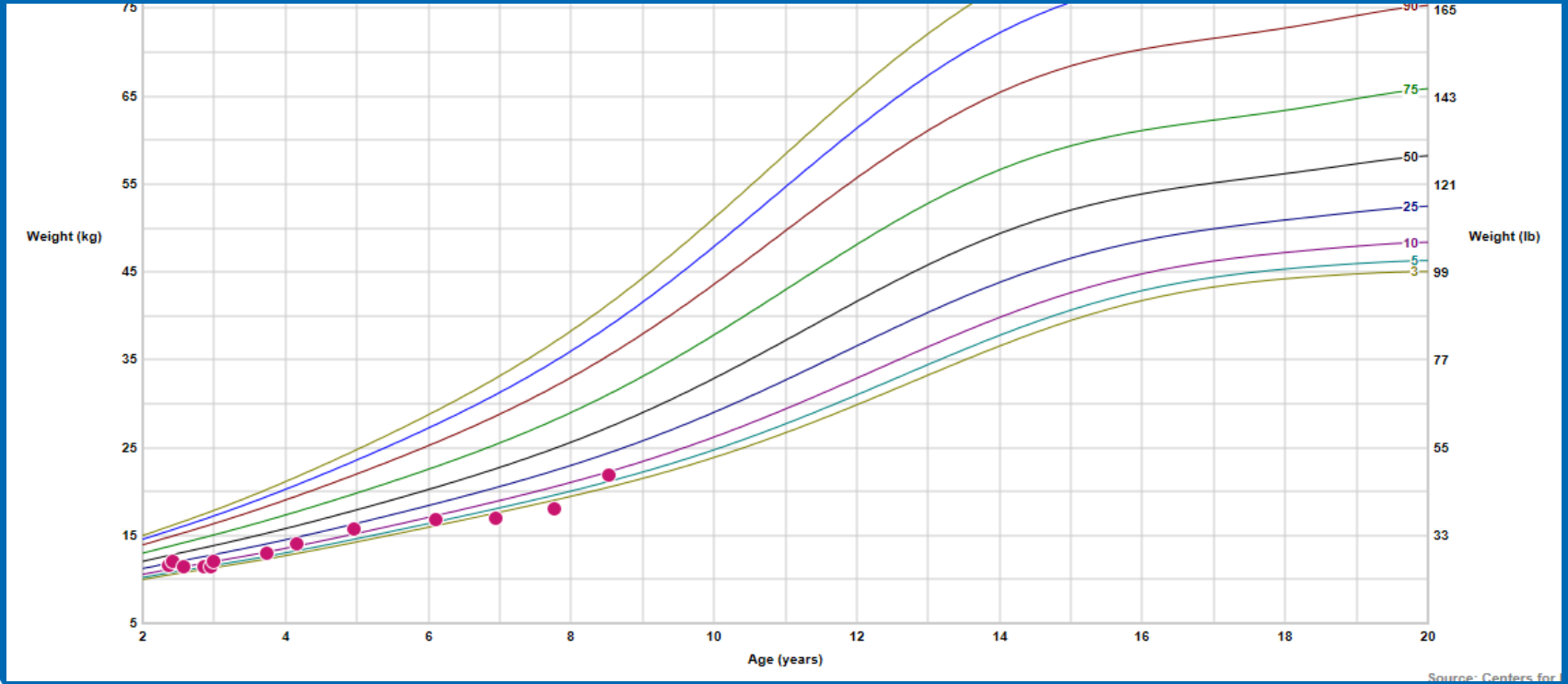
See References slide for additional information.

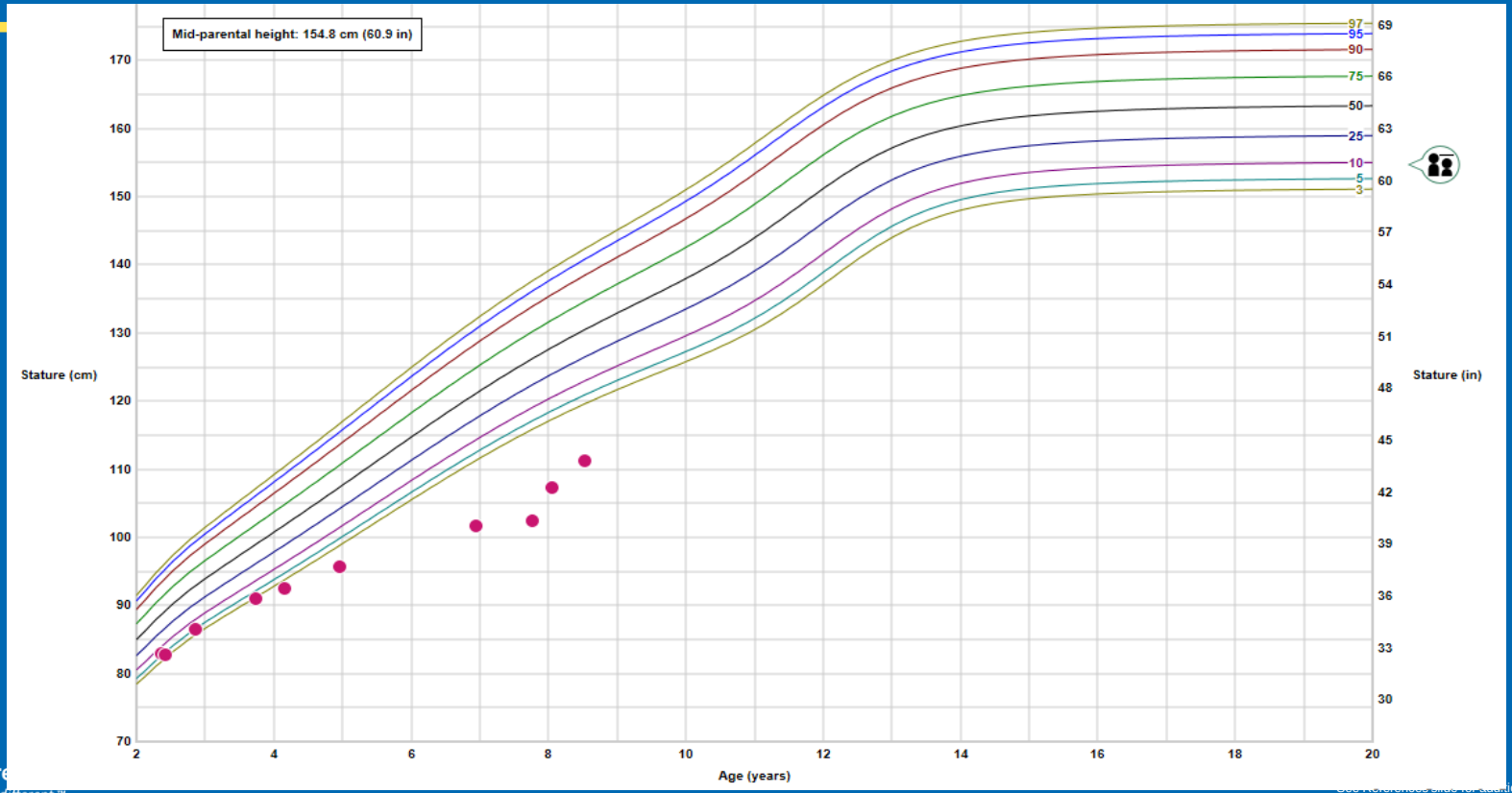
Case Study 5: Weight



(CDC, 2000)

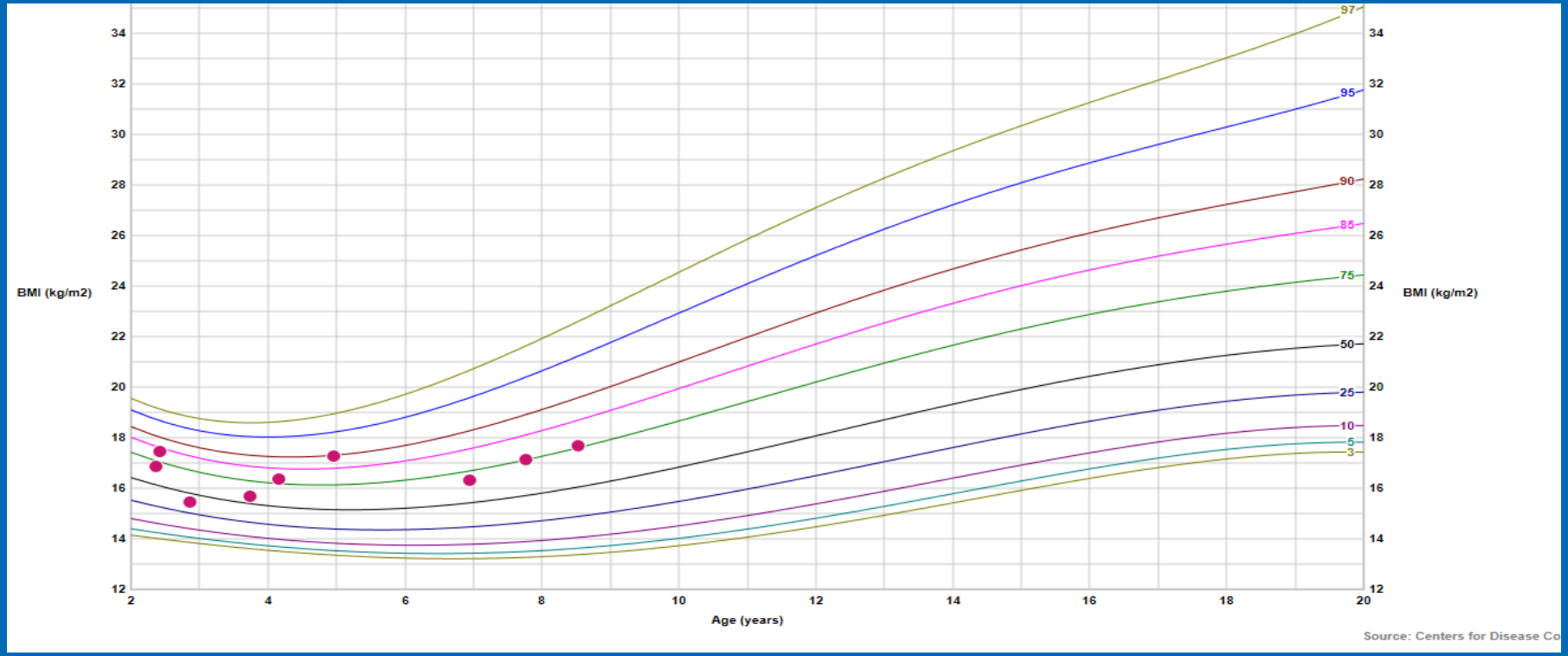
See References slide for additional information.

Case Study 5: Height



(CDC, 2000)

Case Study 4: BMI



(CDC, 2000)

See References slide for additional information.

Case Study 5: Nutrition Status Assessment

• Is this child malnourished ? Why yes and why not?

•What do you think about this child linear growth?

•Final assessment:
No malnutrition
Short stature and severe decrease in linear growth velocity

Linear growth less than 2 inches per year in a pre-pubertal child is abnormal

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Clinical evaluation and management

- Overview: Clinical approach to malnutrition
  - Infants
  - Older Children

- Diagnostic evaluation
  - Discussion of common GI etiologies

- Revisit Cases

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See References slide for additional information.

Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intake
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequate consumption”

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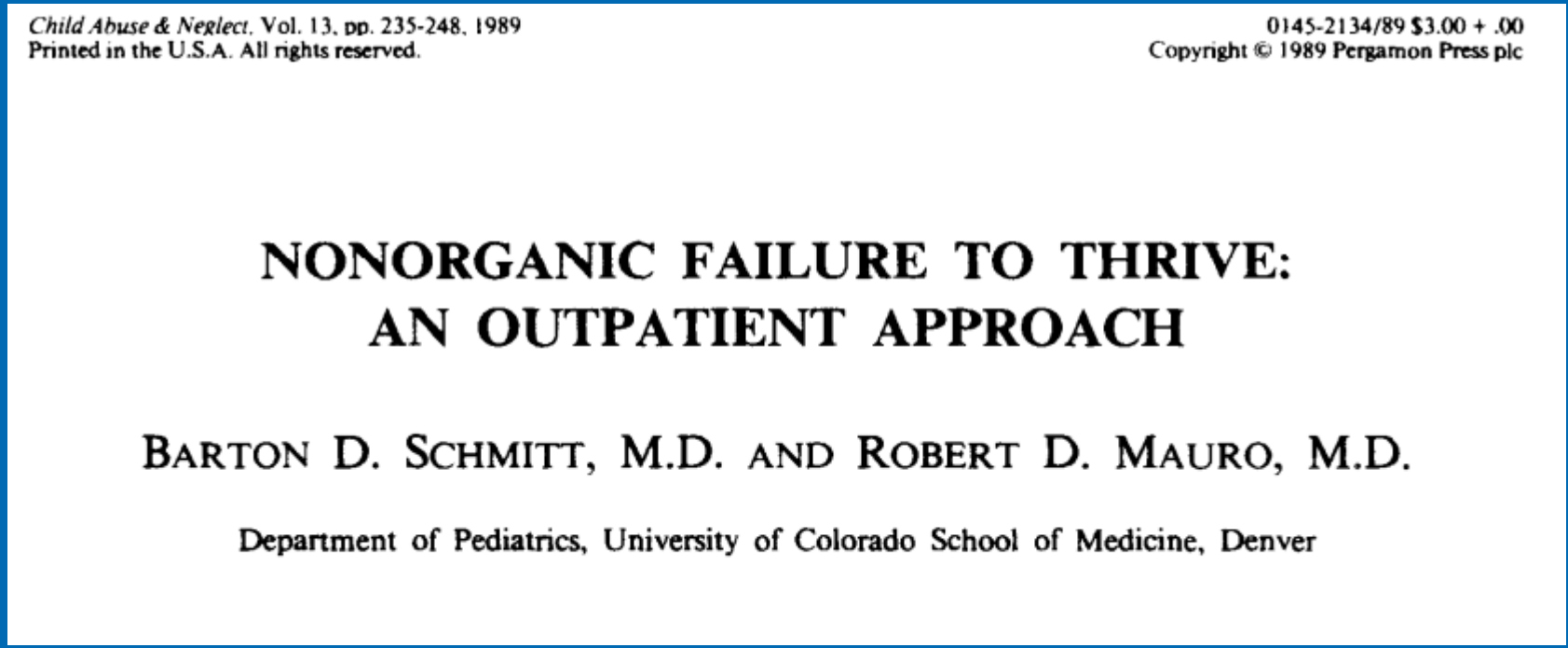
Mechanisms leading to growth faltering (malnutrition)

- 

Child Abuse & Neglect, Vol. 13, pp. 235-248, 1989
Printed in the U.S.A.

0145-2134/89 $3.00 + .00

NONORGANIC FAILURE TO THRIVE: AN OUTPATIENT APPROACH

BARTON D. SCHMITT, M.D. AND ROBERT D. MAURO, M.D.

Department of Pediatrics, University of Colorado School of Medicine, Denver

See References slide for additional information.

Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intake
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequate consumption”

Potential factors leading to inadequate supply:
- Improper formula mixing
- Social determinants of health → Food insecurity
- ? Formula shortages
- Neglect

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See References slide for additional information.

Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intake
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequate consumption”
- **Malabsorptive**

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Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intake
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequate consumption”
- **Malabsorptive**

Potential etiologies (GI)

- Maldigestion: Pancreatic insufficiency
  - Cystic Fibrosis
  - Other (rare): Schwachman Diamond Syndrome
- Malabsorption
  - Celiac disease
  - Other mucosal inflammatory:
    - Allergic/eosinophilic, IBD
  - Infectious: giardia
  - Cholestatic

Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intake
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequate consumption”
- Malabsorptive
- **Increased energy expenditure**
- **Abnormal energy utilization**

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See References slide for additional information.

Mechanisms leading to growth faltering (malnutrition)

- Inadequate energy (caloric) intak
  - most common
  - “Organic” versus “Nonorganic”
  - “Inadequate supply” versus “Inadequat
- Malabsorptive
- **Increased energy expenditure**
- **Abnormal energy utilization**

Potential etiologies:

- Increased metabolic demand:
  - Cardiopulmonary disease
  - Inflammatory
  - Malignancy
- Defective energy utilization
  - Genetic
  - Inborn errors of metabolism
  - *Often multifactorial*

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See References slide for additional information.

Diagnostic Evaluation: History and Physical Exam

- Feeding history
  - Formula mixing
  - Food insecurity
- Red flags in recurrent infant vomiting:
  - Projectile, bilious, lethargy, diarrhea, fevers
- Developmental assessment
- Family history (atopy, genetic/metabolic disorders, etc)
- When possible, observation of feeding
- Exam: Nutritional status / micronutrient deficiencies
  - Etiology

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See References slide for additional information.

Staged Intervention for Malnutrition

- Increase calories
- Change infant formula
- Structured meal times
- Limit juice
- Limit grazing
- Multivitamin supplementation
- Follow up

- When necessary:
  - Further diagnostic evaluations (history / exam dependent)
  - Consider admission
  - Consider supplemental feeds

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Diagnostic Evaluation: Secondary evaluations

- Laboratory evaluations:

  General:

  - CBC, CMP, UA

  Child with wheat / gluten exposure and no other explanation for symptoms:

  - celiac ab testing

  Concern for malabsorption?

  - Fecal fat (spot check), occult blood
  - Consider Giardia
  - Consider Fecal Calprotectin

  Short stature?

  - Thyroid

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See References slide for additional information.

Diagnostic Evaluation: Secondary evaluations

- Feeding concerns?

  Referral to feeding therapy (and/or fluoroscopic swallow study)
  - Infant with poor feeding
  - Toddler/older child with selective eating

- Prominent Upper Gastrointestinal symptoms? vomiting, dysphagia
  - Consider Upper GI series
  - Referral to GI

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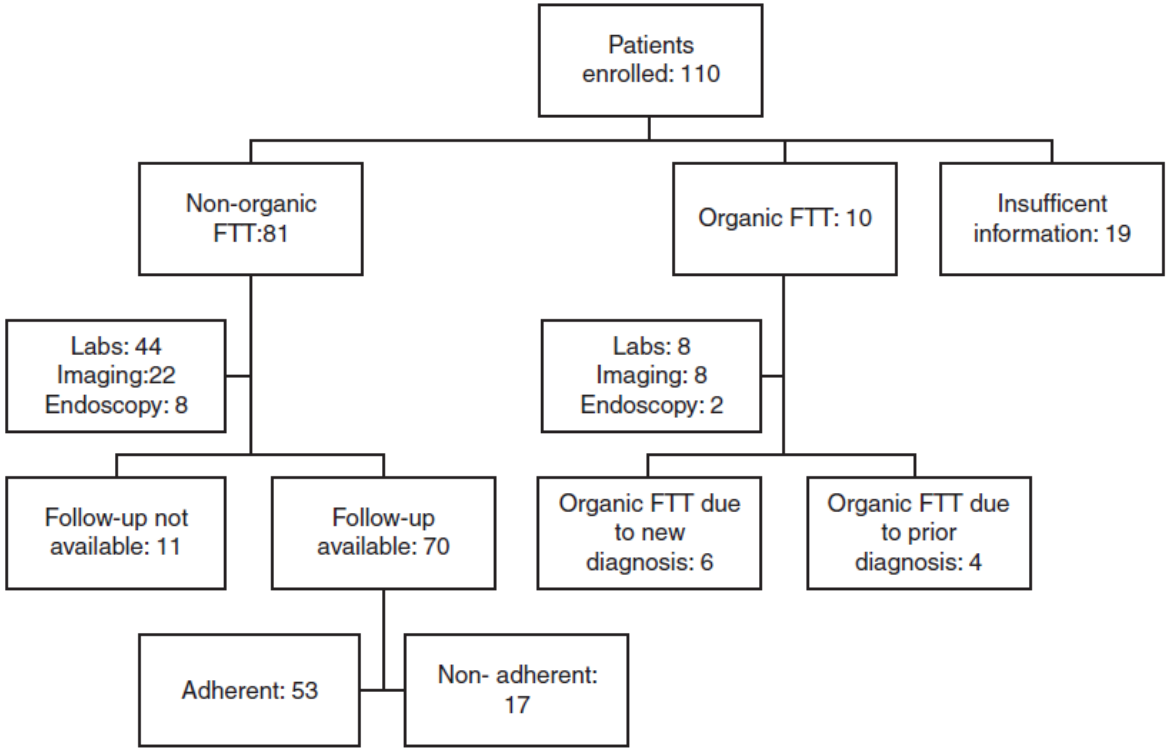
Failure to Thrive: A Prospective Study in a Pediatric Gastroenterology Clinic

*†Catherine M. Larson-Nath and †Praveen S. Goday



JPGN • Volume 62, Number 62, June 2016

Failure to Thrive: A Prospective Study in a Pediatric Gastroenterology Clinic

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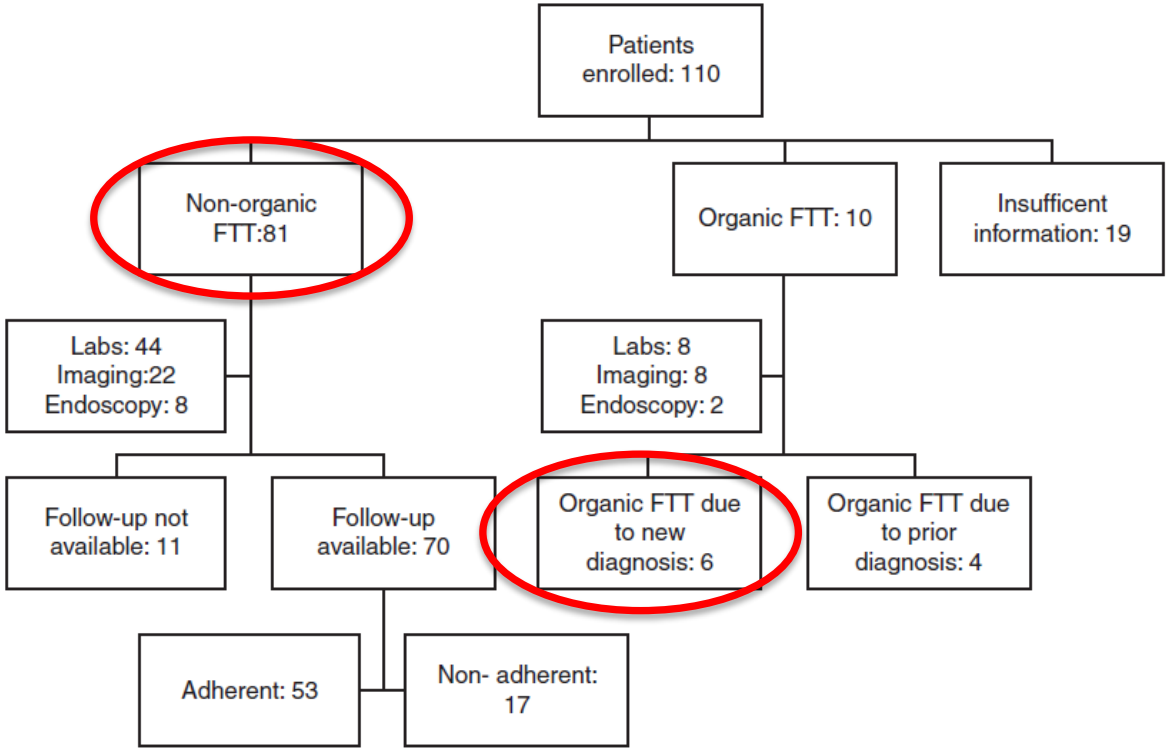

JPGN • Volume 62, Number 62, June 2016

TABLE 3. Frequency of evaluation and results

	Patients with test (%)*			Patients with tests that aids in diagnosis (%)
	All patients	Organic (n = 10)	Nonorganic (n = 81)	
Total	73 (66.3)	10 (100)	53 (65.4)	5 (6.8)
Laboratory	62 (56.4)	8 (80)	44 (54.3)	2 (3.2)
Complete blood count	48 (43.6)	5 (50)	35 (43.2)	0 (0)
Basic metabolic panel†	48 (43.6)	6 (60)	34 (42)	0 (0)
Albumin	43 (39)	3 (30)	27 (33.3)	0 (0)
Thyroid function tests	27 (24.5)	3 (30)	20 (24.7)	0 (0)
Celiac screening	23 (20.9)	1 (10)	18 (22.2)	0 (0)
Genetic testing	7 (6.4)	2 (20)	5 (6.2)	2 (29)
Sweat test	4 (3.6)	2 (20)	2 (2.5)	0 (0)
Imaging	32 (29.6)	8 (80)	22 (27.2)	1 (3.1)
Echocardiogram	5 (5)	1 (1)	4 (4.9)	0 (0)
Chest x-ray	11 (10)	3 (30)	8 (9.9)	0 (0)
Upper gastrointestinal fluoroscopy	15 (15)	5 (50)	9 (11.1)	0 (0)
Cranial imaging	9 (8)	1 (10)	7 (8.6)	1 (11)
Endoscopy	12 (10.9)	2 (20)	8 (9.9)	2 (16.7)
Upper endoscopy	12 (10.9)	2 (2)	8 (9.9)	2 (16.7)
Colonoscopy	2 (1.8)	0 (0)	2 (2.5)	0 (0)

(Larson-Nath & Goday, 2016)

See References slide for additional information.

Hospitalization for Failure to Thrive: A Prospective Descriptive Report

Clinical Pediatrics
2018, Vol. 57(2) 212–219

DOI: 10.1177/0009922817698803
journals.sagepub.com/home/cpj
SAGE

Catherine Larson-Nath, MD[1], Nicole St Clair, MD[1], and Praveen Goday, MBBS[1]

92 children enrolled (124 admissions)
Mean age 0.28 years
14/92 patients: “new dx” discovered during admission/evaluations
Majority of evaluations (imaging, labs, endoscopy): normal
68%: “nonorganic” FTT

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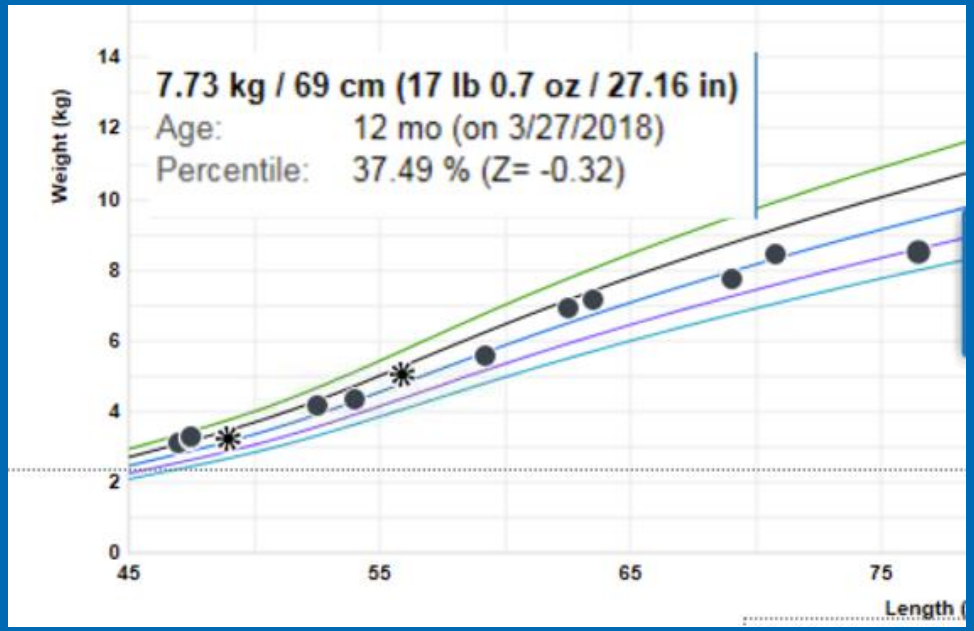
Case 1: 18 month old with mild malnutrition



History and physical exam:
Grazes, large milk intake
No atopy
No dysphagia
No diarrhea/malabsorption
Aunt: celiac disease

Eval:
Normal exam
NEXT STEPS?

Management:
NEXT STEPS?

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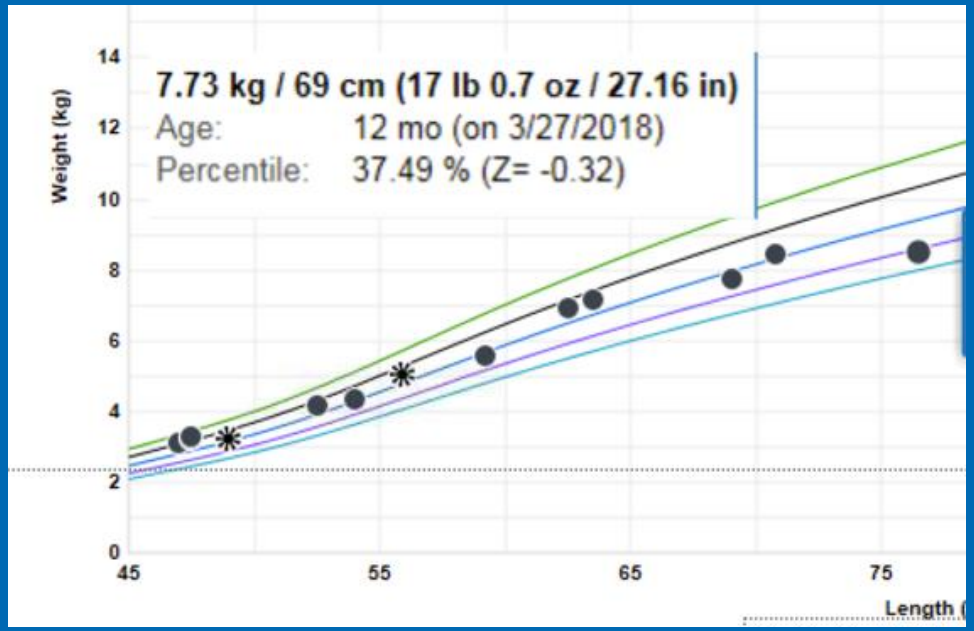
(CDC, 2000)

See References slide for additional information.

Case 1: 18 month old with mild malnutrition



(CDC, 2000)

History and physical exam:
Grazes, large milk intake
No atopy
No dysphagia
No diarrhea/malabsorption
Aunt: celiac disease

Eval:
Normal exam
labs, including celiac ab negative

Management:
Conservative
Increase caloric intake
Improves

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Celiac Disease (in one slide)

- Incidence as high as 3.1% of children in Colorado
- Presentation: varied, from classic GI symptoms, non-GI symptoms, to asymptomatic
- Who to screen:
  - Symptomatic
  - At risk:
  - Autoimmune/Immunologic risk: T1D, Thyroid, Arthritis, AIH, IgA deficiency
  - Genetic: Turners, Trisomy 21, Williams
  - Inherited: first degree family member celiac
- How to screen:
  - TTG IgA and total IgA
- Biopsy confirmation: still recommended, should be discussed

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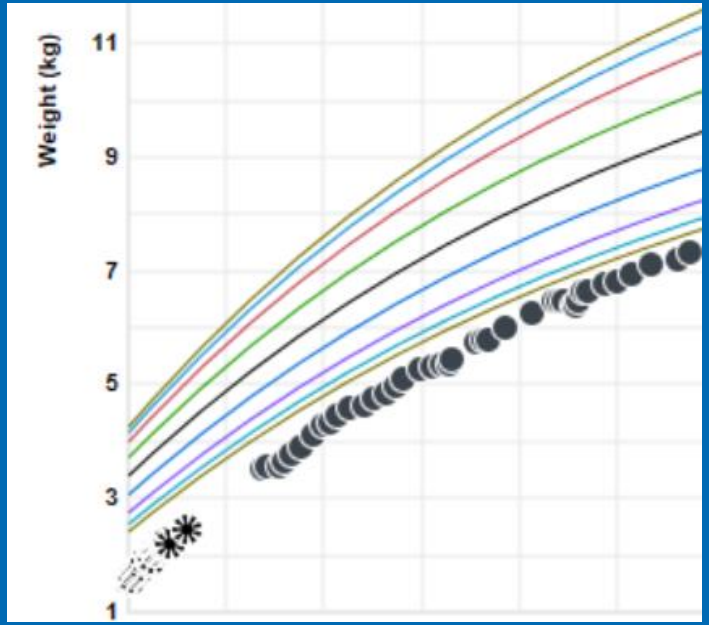
See References slide for additional information.

Case 2: Fussy infant with Poor feeding

- 2 month old, former term IUGR, first child for this family
- Frequent Spitting up / Vomiting
- Pain behavior with feeds
- Breast fed, formula supplementation
- On acid suppression

- Physical exam: normal



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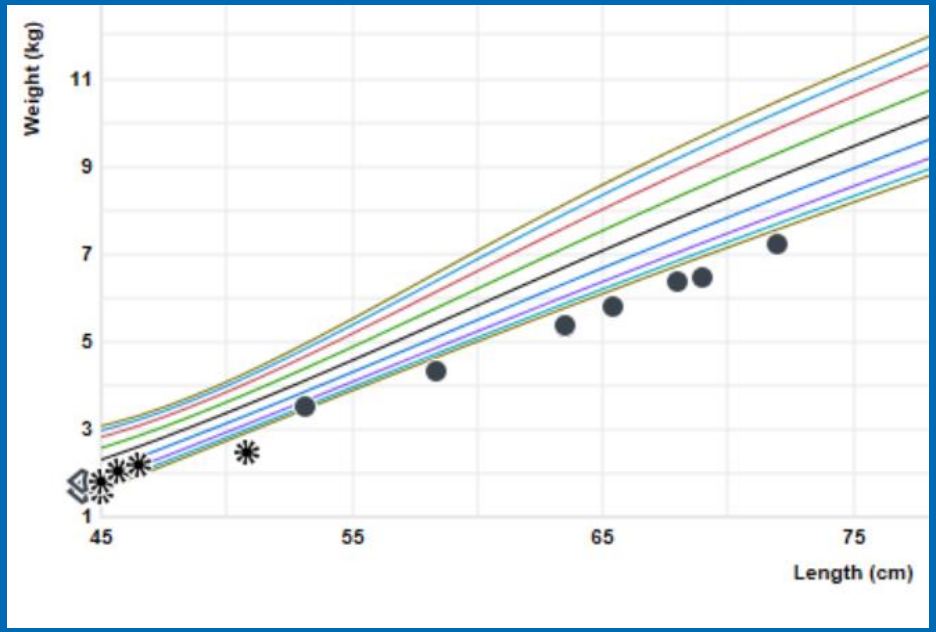
- On acid suppression

- Physical exam: normal



(CDC, 2000)

See References slide for additional information.

Case 2: Diagnostic Considerations

- GERD? = Aspiration ? = Milk protein intolerance?
- Interventions:
  - Maternal dairy restriction, Change in formula
  - Limited trial of acid suppression
- Diagnostic evaluations:
  - UGI series
  - Swallow Study
  - Endoscopy
- Case outcome

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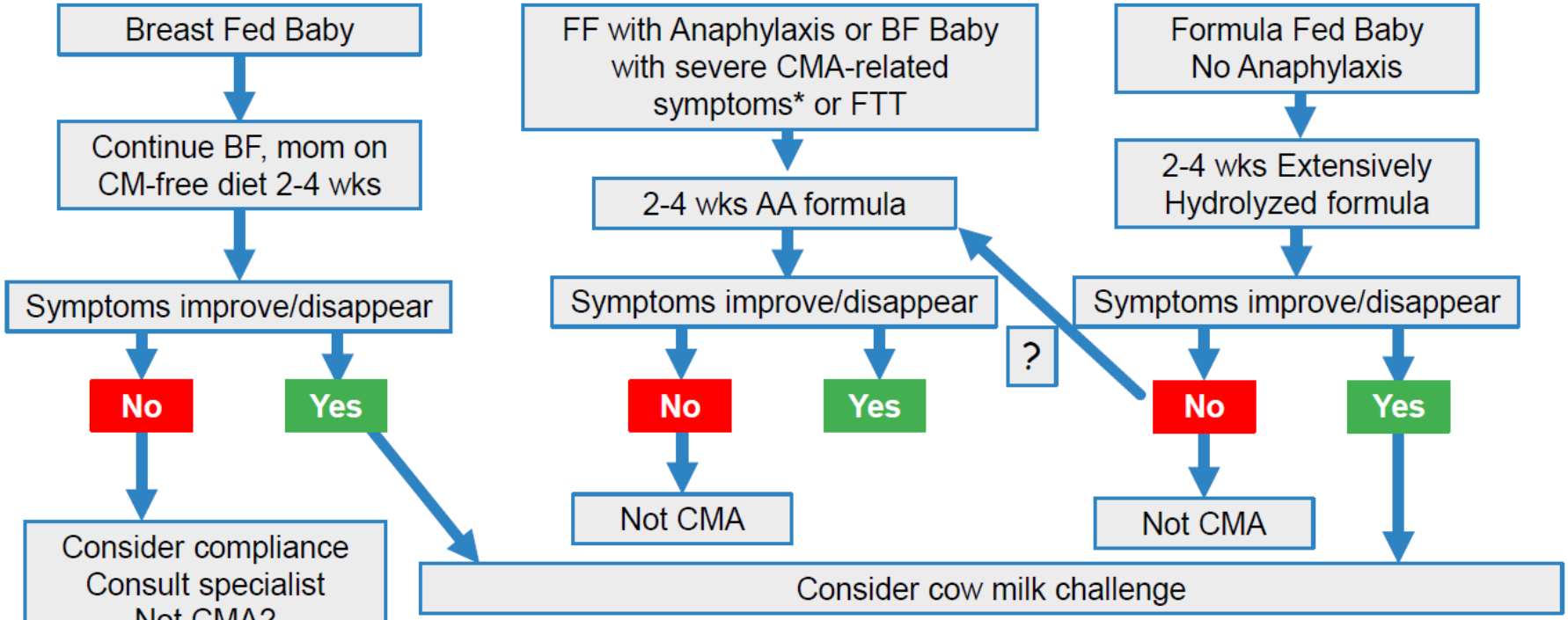
Algorithm for Management of CMA



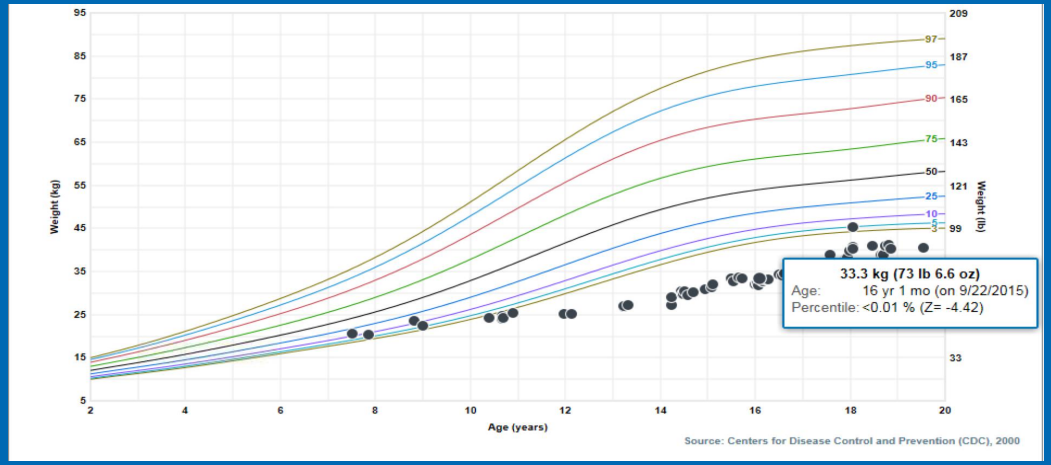
*Severe CMA-related symptoms: severe eczema or enterocolitis with growth faltering, hypoproteinemia, or severe anemia

Long-Term Management
Elimination of CM sources
If BM not available, consider eHF or AAF for at least 6 mo or until infant is 9-12 mo of age; monitor for tolerance

Vandenplas et al. *Acta Pediatrica* 2015

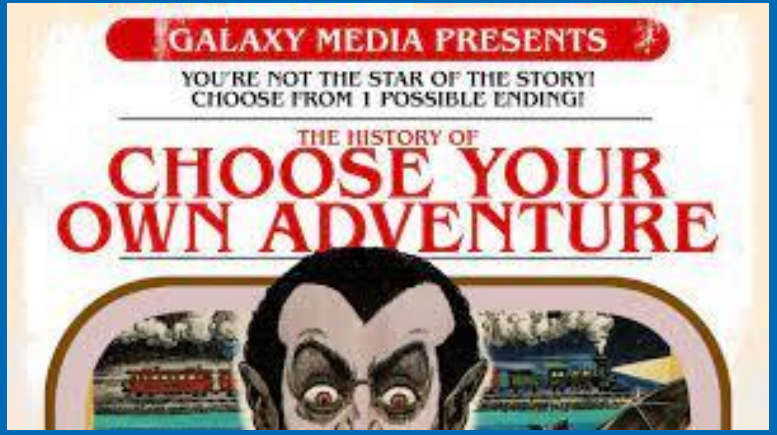
Case 3: Adolescent with severe malnutrition

16 year old male:
- Atopic history
- Anxiety
- No family h/o autoimmunity
- Questions:
  - ? Dysphagia
  - ? Nausea / early satiety
  - ? IBD symptoms
  - ? Psych / ED history
- Exam:
  - Malnourished
  - Not localized



(CDC, 2000)

See References slide for additional information.

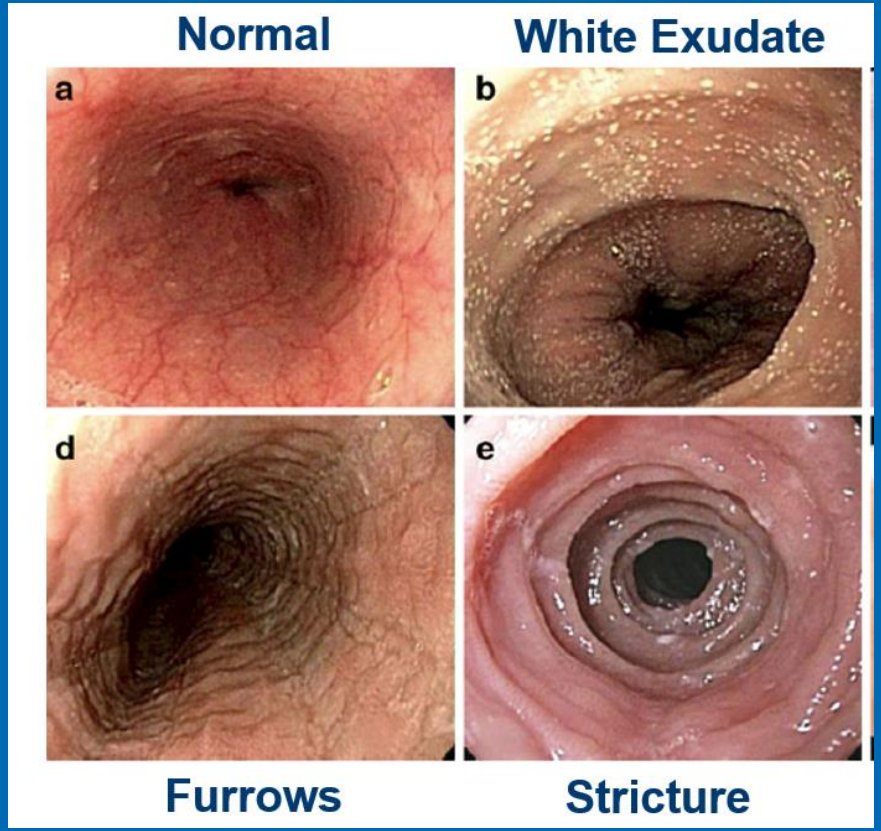


https://www.goodreads.com/book/show/754981.Vampire_Express

See References slide for additional information.

Case 3: Evaluation

- History suggests dysphagia / food sticking
  - Upper GI series: no stricture
  - Refer to GI
  - Endoscopy → EoE



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Eosinophilic Esophagitis (in one slide)

- Increasing prevalence
- Most patients have additional atopic disorder
- Symptoms:

Younger children: food refusal, feeding difficulties, gagging, vomiting, regurgitation, abdominal pain, food impaction

Older children: chest pain, food impaction, regurgitation, dysphagia

- Diagnosis:

Endoscopy/biopsy: > 15 eo/HPF

- Multidisciplinary

  Medical: Swallowed topical corticosteroids

  Nutrition: Elimination diet

  Feeding therapy

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Case 3: Alternative history/outcome

- History: no dysphagia. Predominant nausea. No overt intentional caloric restriction.
- Exam: malnourished, otherwise normal
- Lab evaluations:

  CBC, Thyroid, ESR, CMP, UA, Celiac: Normal
- Diagnosis / next steps?

  Functional GI disorder with malnutrition

  Low yield of abnormal endoscopy or additional evaluations
- Treatment:

  Pharmacologic: cyproheptadine

  Psychology

  Nutrition
- ? ARFID

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Conclusions

- We recommend using precise criteria when defining pediatric malnutrition
- Conservative interventions to restore weight may be of higher yield than testing, unless history and physical exam lead you to consider certain diagnoses
- Referral to either Clinical Nutrition or Pediatric Gastroenterology may be helpful for refractory or concerning patients

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See References slide for additional information.

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Thank You

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